Abstract

A projection optical system (20), exposure apparatus (10) incorporating same, and methods pertaining to same, for manufacturing devices and elements, such as integrated circuits, crystal displays, detectors, MR (magneto-resistive) heads, and the like. The projection optical system comprises a first lens group (G1) having positive refractive power, a second lens group (G2) having negative refractive power, a third lens group (G3) having positive refractive power, a fourth lens group (G4) having negative refractive power and a least a first aspherical surface (ASP1), and a fifth lens group (G5) having positive refractive power and an aperture stop (AS). The projection optical system is designed such that paraxial rays traveling parallel to optical axis (A) imagewise to objectwise intersect the optical axis at a location (Q) between the fourth lens group and the fifth lens group. Further, one of the fourth and fifth lens groups includes at least a second aspherical surface (ASP2) arranged between the first aspherical surface in the fourth lens group and the aperture stop. Also, the fifth lens group includes at least a third aspherical surface (ASP3) arranged imagewise of the aperture stop. The projection optical system also satisfies at least one of a number of design conditions.